

FORM PTO-1390 (Modified) (REV 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER <b>68142-015</b>	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR <b>09/937583</b>	
INTERNATIONAL APPLICATION NO. <b>PCT/GB00/01253</b>		INTERNATIONAL FILING DATE <b>3 April 2000 (03.04.00)</b>		PRIORITY DATE CLAIMED <b>1 April 1999 (01.04.99)</b>	
TITLE OF INVENTION <b>FUEL FILTER</b>					
APPLICANT(S) FOR DO/EO/US <b>DECAUX, Daniel Henri; GAUTHIER, Alan; and VAN HOUTTE, Stephane Jacques Henri</b>					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2))</p> <p>a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>a. <input type="checkbox"/> is attached hereto.</p> <p>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))</p> <p>a. <input checked="" type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input type="checkbox"/> have been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).</p> <p>11. <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409).</p> <p>12. <input type="checkbox"/> A copy of the International Search Report (PCT/ISA/210).</p> <p><b>Items 13 to 20 below concern document(s) or information included:</b></p> <p>13. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>15. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</p> <p>16. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</p> <p>17. <input type="checkbox"/> A substitute specification.</p> <p>18. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>19. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>20. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>21. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>22. <input checked="" type="checkbox"/> Certificate of Mailing by Express Mail</p> <p>23. <input type="checkbox"/> Other items or information:</p>					

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

INTERNATIONAL APPLICATION NO.

ATTORNEY'S DOCKET NUMBER

09/937583

PCT/GB00/01253

68142-015

24. The following fees are submitted:

BASIC NATIONAL FEE ( 37 CFR 1.492 (a) (1) - (5) ) :

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... \$1000.00
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... \$860.00
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$710.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... \$690.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).

☐ 20 ☐ 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	13 - 20 =	0	x \$18.00	\$0.00
Independent claims	1 - 3 =	0	x \$80.00	\$0.00
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>	\$0.00

TOTAL OF ABOVE CALCULATIONS =

\$860.00

- ☒ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.

\$0.00

SUBTOTAL =

\$860.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).

☐ 20 ☐ 30

\$0.00

TOTAL NATIONAL FEE =

\$860.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

☐

\$0.00

TOTAL FEES ENCLOSED =

\$860.00

Amount to be refunded \$  
charged \$

- a. ☒ A check in the amount of \$860.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \_\_\_\_\_ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-2789. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

James R. Yee

NAME

34,460

REGISTRATION NUMBER

September 27, 2001

DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:: Decaux, Gauthier, Van Houtte )  
PCT Serial No.: PCT/GB00/01253 )  
Filed: Herewith )  
For: FUEL FILTER )  
No.: 68,142-015 )

**PRELIMINARY  
AMENDMENT**

Assistant Commissioner of Patents & Trademarks  
Washington, D.C. 20231

Dear Sir:

**PRELIMINARY AMENDMENT**

Prior to examination of the present application, please amend the application as follows:

In the Claims

Please replace claim 1 with the following:

1. (Amended). A fuel filter comprising a filter body having opposing filter body ends, the filter body defining an internal chamber within which a filter medium is to be located, the filter medium including a filter member having a first end secured to a support plate and a second end secured to the filter body, the filter body being of multi-part construction, the parts of the filter body being non-removably, sealingly secured to one another, the filter body being shaped to define an inlet port and an outlet port communicating with dirty and clean sides of the filter medium, respectively both the inlet and the outlet ports being positioned at the same body end of the filter body.

Please replace claim 2 with the following:

2. (Amended). The filter as claimed in Claim 1, wherein the parts of the filter body are secured to one another by means of a friction welding technique.

Please replace claim 3 with the following:

3. (Amended). The filter as claimed in Claim 1, wherein the filter medium is a pleated paper filter member.

Please replace claim 4 with the following:

4. (Amended). The filter as claimed in Claim 1, wherein the second end of the filter member is bonded directly to the filter body.

Please replace claim 5 with the following:

5. (Amended). The filter as claimed in Claim 1, wherein the filter body further defines a second inlet port and a return port.

Please replace claim 6 with the following:

6. (Amended). The filter as claimed in Claim 5, further comprising a temperature sensitive valve operable to control whether fuel entering the filter body through the second inlet port is supplied to the dirty side of the filter medium or supplied to the return port for return to a fuel reservoir.

Please replace claim 8 with the following:

8. (Amended). The filter as claimed in Claim 7, wherein the ball valve comprises a valve member which is moveable under the influence of a bimetallic element.

Please replace claim 9 with the following:

9. (Amended). The filter as claimed in Claim 7, further comprising a non-return valve member resiliently biased into engagement with a seating to ensure that fuel is able to flow from the second inlet port to the return port, but to substantially prevent fuel and/or gas vapour flow in the reverse direction.

Please replace claim 10 with the following:

10. (Amended). The filter as claimed in Claim 9, wherein the non-return valve member comprises a plate formed from rubber or a rubber-like material.

Please replace claim 11 with the following:

11. (Amended). The filter as claimed in Claim 1, further comprising a downwardly depending tubular member which is secured to the filter body, the tubular member serving to force fuel flow in a downward direction prior to entering the tubular member, in use.

Please replace claim 12 with the following:

12. (Amended). The filter as claimed in Claim 11, wherein the tubular member is provided with one or more openings through which air is able to flow at a relatively low rate.

Please add new claim 13.

13. (New) The filter as claimed in Claim 3, wherein the second end of the filter member is bonded directly to the filter body.

Please delete the abstract in its entirety and replace with the following:

ABSTRACT  
FILTER

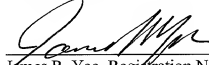
A fuel filter comprising a filter body defining an internal chamber within which a filter medium is to be located, the filter body being of multi-part construction, the parts of the filter body being non-removably, sealingly secured to one another. The filter body is shaped to define an inlet port and an outlet port communicating with dirty and clean sides of the filter medium, respectively. The fuel filter may also include a second inlet port for receiving fuel, a return port arranged to permit the return flow of fuel from the filter to a low pressure fuel reservoir, and a temperature sensitive valve operable to control whether fuel entering the filter body through the second inlet port is supplied to the dirty side of the filter medium or supplied to the return port for return to the fuel reservoir.

Remarks

No new matter has been added by this amendment. By this amendment claims 1-6 and 8-12 have been amended and new claim 13 has been added.

Respectfully submitted,

HOWARD & HOWARD ATTORNEYS, P.C.



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**In the Claims (Marked-up Version)**

1. (Amended). A fuel filter comprising a filter body [(10)] having opposing filter body ends, the filter body defining an internal chamber [(15)] within which a filter medium [(16)] is to be located, the filter medium including a filter member having a first end secured to a support plate [(17)] and a second end secured to the filter body [(10)], the filter body [(10)] being of multi-part construction, the parts [(10a, 10b)] of the filter body [(10)] being non-removably, sealingly secured to one another, the filter body [(10)] being shaped to define an inlet port [(11)] and an outlet port [(13)] communicating with dirty and clean sides of the filter medium, respectively both the inlet and the outlet ports being positioned at the same body end of the filter body.

2. (Amended). The filter as claimed in Claim 1, wherein the parts [(10a, 10b)] of the filter body [(10)] are secured to one another by means of a friction welding technique.

3. (Amended). The filter as claimed in Claim 1 [or 2], wherein the filter medium [(16)] is a pleated paper filter member.

4. (Amended). The filter as claimed in Claim 1 [to 3], wherein the second end of the filter member is bonded directly to the filter body [(10)].

5. (Amended). The filter as claimed in [any of Claims 1 to 4] Claim 1, wherein the filter body [(10)] further defines a second inlet port [(12)] and a return port [(14)].

6. (Amended). The filter as claimed in Claim 5, further comprising a temperature sensitive valve [(22)] operable to control whether fuel entering the filter body [(10)] through the second inlet port [(12)] is supplied to the dirty side of the filter medium [(16)] or supplied to the return port [(14)] for return to a fuel reservoir.

8. (Amended). The filter as claimed in Claim 7, wherein the ball valve comprises a valve member [(22)] which is moveable under the influence of a bimetallic element [(21)].

9. (Amended). The filter as claimed in [any one of Claims 6 to 8] Claim 7, further comprising a non-return valve member [(24)] resiliently biased into engagement with a



seating [(26)] to ensure that fuel is able to flow from the second inlet port [(12)] to the return port [(14)], but to substantially prevent fuel and/or gas vapour flow in the reverse direction.

10. (Amended). The filter as claimed in Claim 9, wherein the non-return valve member [(24)] comprises a plate formed from rubber or a rubber-like material.

11. (Amended). The filter as claimed in [any of Claims 1 to 8] Claim 1, further comprising a downwardly depending tubular member [(18)] which is secured to the filter body [(10)], the tubular member [(18)] serving to force fuel flow in a downward direction prior to entering the tubular member [(18)], in use.

12. (Amended). The filter as claimed in Claim 11, wherein the tubular member [(18)] is provided with one or more openings [(19)] through which air is able to flow at a relatively low rate.

13. (New) The filter as claimed in Claim 3, wherein the second end of the filter member is bonded directly to the filter body.

ABSTRACT  
FILTER

201710-0852660 00037583-011802

A fuel filter comprising a filter body [(10)] defining an internal chamber [(15)] within which a filter medium [(16)] is to be located, the filter body [(10)] being of multi-part construction, the parts [(10, 10)] of the filter body [(10)] being non-removably, sealingly secured to one another. The filter body [(10)] is shaped to define an inlet port [(11)] and an outlet port [(13)] communicating with dirty and clean sides of the filter medium, respectively. The fuel filter may also include a second inlet port [(12)] for receiving fuel, a return port [(14)] arranged to permit the return flow of fuel from the filter to a low pressure fuel reservoir, and a temperature sensitive valve [(22)] operable to control whether fuel entering the filter body [(10)] through the second inlet port [(12)] is supplied to the dirty side of the filter medium [(16)] or supplied to the return port [(14)] for return to the fuel reservoir.

PTO/PCT Rec'd 27 SEP 2001

**FUEL FILTER**

This invention relates to a filter for use in a fuel system suitable for use in supplying fuel to a compression ignition internal combustion engine.

A filter is incorporated into the fuel system used with a compression ignition internal combustion engine in order to remove particulate contaminants from the flow of fuel to avoid the transmission of such contaminants to, for example, the high pressure fuel pump or the injectors of the fuel system. This is advantageous as the transmission of such contaminants may result in increased wear rates for components of the fuel system or in failure of the components.

A typical filter comprises a filter head including connection ports connected to various parts of the fuel system and a filter bowl removably secured to the filter head and containing a filter medium. The filter medium may form part of a removable filter cartridge located within the filter bowl.

During maintenance, the filter bowl is removed from the filter head and the filter medium is replaced. The bowl is then reattached to the filter head. A number of techniques are known for securing the filter bowl to the filter head. For example a bolt may extend through the filter head and bowl, a nut engaging the bolt to secure the filter head and bowl to one another. Alternatively, the filter bowl and head may be provided with formations which cooperate with one another to secure the filter head and bowl to one another. In either case, a seal arrangement must be provided to avoid fuel leakage between the filter bowl and head.

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The provision of an arrangement for securing the filter head and bowl to one another and locating a seal arrangement therebetween results in the filter being of relatively complex form.

Non serviceable filters in which the filter bowl and filter head are non-separable are known. GB 2121696A discloses an oil filter, particularly for use with internal combustion engines, comprising a casing and an end cap made of thermoplastic material and welded together. These form a housing in which the filter element, and other components are contained.

GB 2333245A discloses a filter head having a variable flow path and comprising a lower chamber, arranged to communicate with a central part of an associated filter, an upper chamber and a plurality of ports. The filter head may also comprise a temperature sensitive valve which controls the flow of fuel from the high pressure fuel pump back to the filter head.

According to the present invention there is provided a fuel filter comprising a filter body defining an internal chamber within which a filter medium is located, the filter body being of multi-part construction, the parts of the filter body being non-removably, sealingly secured to one another, the filter body being shaped to define an inlet port and an outlet port communicating with dirty and clean sides of the filter medium, respectively.

The filter body is preferably a plastics moulded filter body.

2a

As the parts of the filter body are not intended to be separable, replacement of the filter medium during servicing requires replacement of the whole filter. As the filters are pre-assembled, no action needs to be taken during servicing to ensure that fuel leakage from the filter is to be avoided, servicing simply requiring the fuel lines connected to the ports to be removed, the filter replaced with a new filter, and the fuel lines connected to the new filter. The old filter can be discarded.

The parts of the filter body are conveniently secured to one another using a friction welding technique.

Conveniently the filter medium comprises a pleated paper filter member, a first end of which is bonded to a support plate located within the filter body, a second end of the filter member being bonded to the filter body.

The filter body may further define a second inlet port and a return port, and the filter may further comprise a temperature sensitive valve operable to control whether fuel entering the filter body through the second inlet port is supplied to the dirty side of the filter medium or supplied to the return port for return to a fuel reservoir. The valve conveniently comprises a ball valve, the valve member of which is moveable under the influence of a bimetallic element. Such a valve permits relatively hot fuel to be directed towards the filter medium to reduce fuel waxing under cold engine operating conditions. Further, as the relatively hot fuel has already been filtered, prior to being supplied to the pump and returned to the filter, it is unlikely to contain wax particles. This type of valve may also be used in conventional filter arrangements.

The invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a filter in accordance with an embodiment; and

Figure 2 is another sectional view of the filter of Figure 1.

The filter illustrated in the accompanying drawings comprises a two piece plastics moulded filter body 10 which comprises a lower part or bowl 10a and an upper part or cap 10b. The upper and lower parts 10a, 10b are designed in such a manner as to be non-removably, sealingly securable to one another using a friction welding technique. The upper part 10b is shaped to define four integral connection ports in the form of connection nipples. The ports comprise a first inlet port 11, a second inlet port 12, an outlet port 13 and a return port 14. Each port is designed for connection to a fuel line or pipe, the first inlet port 11 being arranged to be connected to an inlet pipe which communicates with a low

pressure fuel reservoir, the second inlet port 12 being connected to a line whereby excess fuel is returned to the filter from a high pressure fuel pump or from the backleak passages of the fuel injectors of the fuel system. The outlet port 13 is connected to the inlet of a high pressure fuel pump, and the return line 14 is arranged to permit the return of fuel from the filter to the low pressure fuel reservoir.

The filter body 10 defines a volume 15 within which a filter medium 16 is located. The filter medium comprises a pleated paper filter member which is of star-like form in cross-sectional shape. The filter medium 16 is supported, at its lower end, by a lower support plate 17, the outer periphery of which engages the inner surface of the lower part 10a. The upper end of the filter medium 16 is bonded to the inner surface of the upper part 10b of the filter body 10. The manner in which the filter medium 16 is bonded to the filter body 10 and lower support plate 17 is such that fuel can only flow from the outer periphery of the filter medium 16 (the dirty side) to an inner part of the filter medium 16 (the clean side) by flowing through the filter medium 16. The outlet port 13 communicates with the clean side of the filter medium 16. As the filter medium 16 is bonded directly to the filter body 10, the provision of an upper support plate can be avoided.

A downwardly depending tubular member 18 is secured to the inner surface of the upper part 10b, the tubular member 18 being coaxial with the outlet 13. The provision of the tubular member 18 serves to force fuel to flow in a downward direction prior to entering the tube 18, the fuel subsequently flowing to the outlet port 13. Any air which is carried with the flow of fuel will tend to rise due to its lower density than the fuel and will tend to collect in the upper part of the filter body 10, very little of the air flowing downwardly with the

flow of fuel to enter the tubular member 18. The tubular member 18 is provided, adjacent its upper end, with one or more small openings 19 through which air is able to pass at a low rate to continue with the flow of fuel from the filter, in use, as a stream of small bubbles. It is thought that the flow of air as a stream of small bubbles is unlikely to cause the performance of components downstream of the filter, for example the high pressure fuel pump, to be impaired compared to the case where relatively large bubbles of air flow from the filter at an uncontrolled rate.

The filter body 10 defines a side chamber 20 which communicates with the volume 15 through openings (not shown) provided in either the upper part or the lower part of the filter body 10. The first inlet port 11 communicates with the side chamber 20, thus fuel flowing to the filter body 10 through the first inlet port 11 will be supplied through the side chamber 20 to the volume 15, the fuel subsequently flowing through the filter medium to the outlet port 13.

As illustrated in Figure 2, a bimetallic member 21 is located within the side chamber 20, the bimetallic member 21 being arranged to flex depending upon the temperature of the fuel within the side chamber 20. The bimetallic member 21 is shaped to cooperate with a spherical valve member 22 which is engageable with a seating 23 to control communication between the second inlet port 12 and the side chamber 20. The bimetallic member 21, valve member 22 and seating 23 together constitute a temperature controlled diverter valve. The bimetallic member 21 is arranged such that, when the fuel temperature within the side chamber 20 is low, the bimetallic member 21 occupies the position illustrated in Figure 2 in which the spherical valve member 22 is lifted from the seating 23, and thus communication is permitted between the second inlet port 12 and the side chamber 20. As the temperature



of the fuel within the side chamber 20 increases, the bimetallic member 21 will flex in a downward direction, thus permitting movement of the valve member 22 towards its seating, restricting fuel flow from the second inlet port 12 to the side chamber 20, and a point will be reached beyond which the valve member 22 is able to engage the seating 23, breaking the communication between the second inlet port 12 and the side chamber 20.

The second inlet port 12 further communicates with the return port 14, a non-return valve in the form of a valve member 24 which is resiliently biased by a spring 25 into engagement with a seating 26 conveniently being provided to ensure that fuel is able to flow from the second inlet port 12 to the return port 14, but to substantially prevent fuel and/or gas or vapour flow in the reverse direction. The valve member 24 of the non-return valve conveniently comprises a plate formed of rubber or a rubber-like material. It will be appreciated, however, that the valve member may be of other forms. Similarly, the valve member 22 of the diverter valve may be of a shape other than a spherical shape.

In use, with the ports connected to appropriate fuel lines, operation of the high pressure fuel pump or a low pressure fuel pump located intermediate the filter and the high pressure fuel pump will result in fuel being drawn from the filter through the outlet port 13, and as a result, the fuel pressure at the clean side of the filter medium 16 will fall. The reduced fuel pressure at the clean side of the filter member 16 will result in fuel being drawn from the side chamber 20 to the volume 15 and through the filter medium 16. The action of fuel being drawn from the side chamber 20 will cause fuel to be drawn from the fuel reservoir through the first inlet port 11 to the side chamber 20. Further, if the fuel temperature within the side chamber 20 is relatively low as would occur upon

initial engine start-up under certain atmospheric conditions, then the bimetallic member 21 will occupy a position similar to that illustrated in Figure 2 in which it ensures that the valve member 22 is spaced from its seating 23. In this position, the relatively low pressure within the side chamber 20 will further result in fuel from the second inlet port 12 being drawn towards the side chamber 20. The fuel from the second inlet port 12 is relatively warm as it has been passed through the high pressure fuel pump. It has also been filtered prior to being supplied to the fuel pump. The supply of such warm, filtered fuel to the side chamber 20 and volume 15 will result in the fuel temperature applied to the filter medium 16 being relatively high, and thus the risk of the formation of wax particles within the fuel which may cause choking of the filter medium 16 is reduced. As the fuel temperature within the side chamber 20 increases, the bimetallic member 21 will flex in a downward direction, and the spherical valve member 22 will move towards its seating 23, thus restricting the return of fuel from the second inlet port 12 to the side chamber 20, this flow eventually ceasing. Thus, the proportion of the fuel supplied to the filter medium from the fuel reservoir through the first inlet port 11 will gradually rise.

The provision of the diverter valve leads to the back pressure on the line connected to the second inlet port 12 being very low, and as the valve gradually moves between its fully open and closed positions, the valve does not cause sudden significant variations in the back pressure which could adversely affect operation of the fuel injection equipment connected to this line.

The provision of the non-return valve between the second inlet port 12 and the return port 14 is particularly advantageous when the spherical valve member 22 is lifted from its seating as, in the absence of such a non-return valve, in addition to drawing fuel from the second inlet port 12 to the side chamber 20, if

the end of the passage or fuel line remote from the end which is connected to the return port 14 is not permanently submerged in fuel, then air or vapour may be drawn into the side chamber 20. Where the line connected to the return port 14 is continuously submerged, then the provision of the non-return valve is of less importance. Indeed, where the provision of the non-return valve can be avoided, then it will be appreciated that the location of the return port 14 in the upper part of the filter body 10 results in the provision of a permanent air vent whereby air can be bled to the fuel tank.

As described hereinbefore, during operation of the filter, air will tend to accumulate within the upper part of the chamber 15 rather than passing in an uncontrolled manner in the form of large bubbles through the outlet port 13. The air collected in the upper part of the filter body 10 will continue with the flow of fuel in a controlled manner in the form of a stream of small air bubbles, the formation of the small air bubbles resulting from the passage of the air through the small openings 19.

In addition to the separation of air from the fuel, water and other relatively dense contaminants will tend to separate from the fuel, these contaminants tending to flow in a downward direction, passing between the lower support plate 17 and the lower part 10a through openings 17a provided in the outer periphery of the lower support plate 17, the water and dense contaminants collecting in the bottom of the lower part 10a. If desired, a drainage hole may be provided in the lower part 10a, the drainage hole being closed by an appropriate plug in use, the plug being removed at appropriate intervals to permit the drainage of water and dense contaminants from the body 10.

The operation which must be performed upon servicing in order to replace the filter medium is relatively simple compared to the operations necessary with conventional filters in that all that is required is for the fuel lines to be removed from the ports, the filter body 10 removed and replaced with a fresh filter body containing a fresh filter medium, and the fuel lines connected to the ports of the new filter body 10. As the parts of the filter body 10 are non-removably, sealingly secured to one another during manufacture, no steps need to be performed during the servicing procedure to secure the various parts of the filter to one another or to ensure that an appropriate seal is formed.

Although the description hereinbefore is of a filter having a filter medium of star-like, pleated paper form, and incorporating a temperature sensitive diverter valve for the avoidance of choking of the filter due to the wax formation, and air management facilities, it will be appreciated that depending upon the application in which the filter is to be used, modifications can be made to the filter to omit or alter the form of the various parts of the filter. Further, any shape can be chosen for the filter body, the choice of shape not being limited by the need to provide a seal arrangement.

The diverter valve illustrated in Figure 2 may also be incorporated within a conventional filter head, if desired, and this patent application extends to the use of such a diverter valve in a typical filter head.

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**CLAIMS**

1. A fuel filter comprising a filter body (10) defining an internal chamber (15) within which a filter medium (16) is to be located, the filter medium including a filter member having a first end secured to a support plate (17) and a second end secured to the filter body (10), the filter body (10) being of multi-part construction, the parts (10a, 10b) of the filter body (10) being non-removably, sealingly secured to one another, the filter body (10) being shaped to define an inlet port (11) and an outlet port (13) communicating with dirty and clean sides of the filter medium, respectively.
2. The filter as claimed in Claim 1, wherein the parts (10a, 10b) of the filter body (10) are secured to one another by means of a friction welding technique.
3. The filter as claimed in Claim 1 or 2, wherein the filter medium (16) is a pleated paper filter member.
4. The filter as claimed in Claim 1 to 3, wherein the second end of the filter member is bonded directly to the filter body (10).
5. The filter as claimed in any of Claims 1 to 4, wherein the filter body (10) further defines a second inlet port (12) and a return port (14).
6. The filter as claimed in Claim 5, further comprising a temperature sensitive valve (22) operable to control whether fuel entering the filter body (10) through the second inlet port (12) is supplied to the dirty side of the filter medium (16) or supplied to the return port (14) for return to a fuel reservoir.

7. The filter as claimed in Claim 6, wherein the temperature sensitive valve comprises a ball valve.

8. The filter as claimed in Claim 7, wherein the ball valve comprises a valve member (22) which is moveable under the influence of a bimetallic element (21).

9. The filter as claimed in any one of Claims 6 to 8, further comprising a non-return valve member (24) resiliently biased into engagement with a seating (26) to ensure that fuel is able to flow from the second inlet port (12) to the return port (14), but to substantially prevent fuel and/or gas vapour flow in the reverse direction.

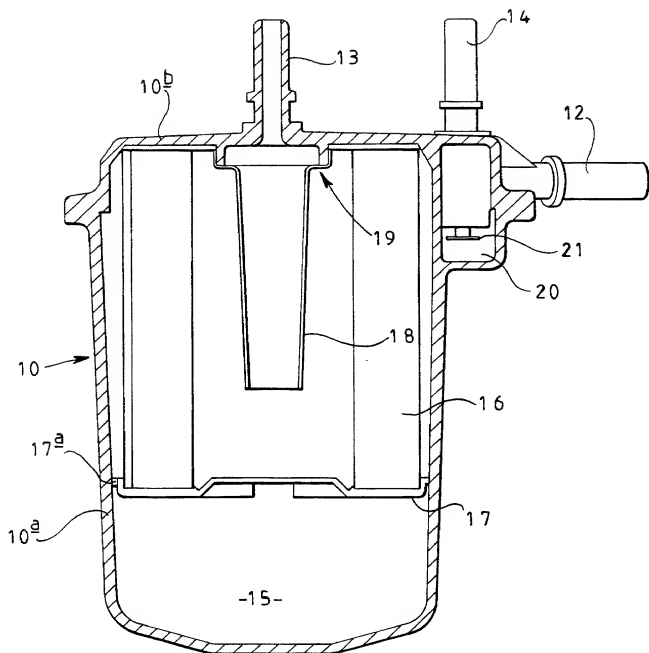
10. The filter as claimed in Claim 9, wherein the non-return valve member (24) comprises a plate formed from rubber or a rubber-like material.

11. The filter as claimed in any of Claims 1 to <sup>10</sup>~~8~~, further comprising a downwardly depending tubular member (18) which is secured to the filter body (10), the tubular member (18) serving to force fuel flow in a downward direction prior to entering the tubular member (18), in use.

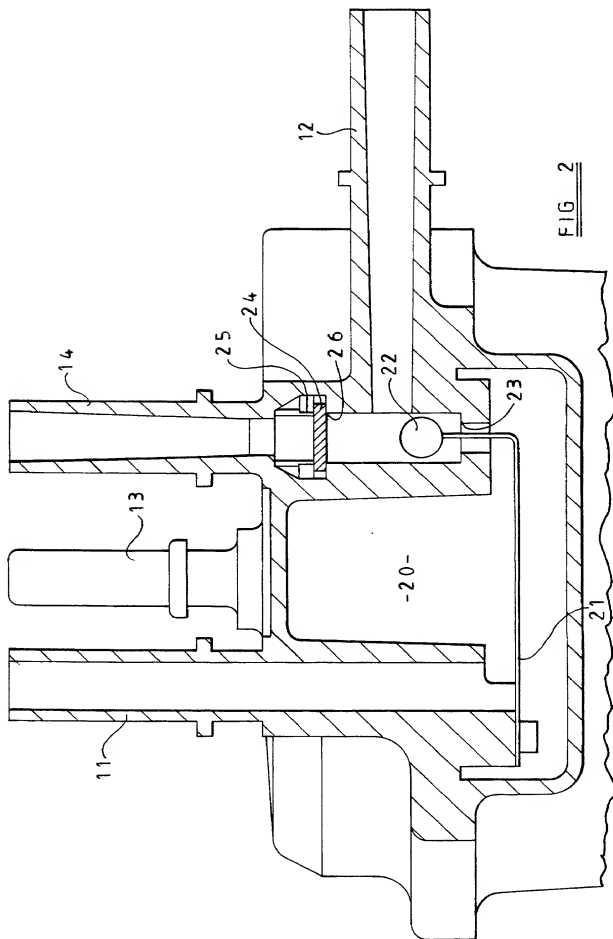
12. The filter as claimed in Claim 11, wherein the tubular member (18) is provided with one or more openings (19) through which air is able to flow at a relatively low rate.

was originally 10  
- don't know why  
it was changed to  
8!

1 / 2

FIG 1

2 / 2





COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR UNITED STATES PATENT APPLICATION

As below named inventors, we hereby declare that:

Our residences, post office addresses and citizenship are as stated near our names below.

We believe we are the original, first and sole inventors of the subject matter of which is claimed and for which a patent is sought on the invention entitled:

**FILTER**

which is described and claimed in the specification of which:

- ☒ is executed on even date herewith; attorney docket number 60,408-120
- ☐ was filed on \_\_\_\_\_, as United States Application Serial No. \_\_\_\_\_, Attorney Docket No. .

We declare that this application is:

- ☒ a first filing.
- ☐ a continuation.
- ☐ a continuation-in-part.
- ☐ a divisional.

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We do not know and do not believe our invention was known or used by others in the United States of America, or patented or described in a printed publication in any country before our invention thereof.

We do not know and do not believe our invention was patented or described in a printed publication in any country or in public use or on sale in the United States of America, more than one year prior to this application.

We acknowledge my duty to disclose information of which we are aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

14.41 PAGES & CLERK BHM → 90012486451568 NO. 371 0403

We hereby claim that no application for patent or inventor's certificate on this invention has been filed in any foreign country or in the United States of America prior to this application by our or my legal representatives or assigns except as follows:

### PRIORITY CLAIM

We hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of the foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

- ☐ no such applications have been filed.
- ☒ such applications have been filed as follows:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED UNDER 37 USC 119
GB	9907564.0	01/04/99	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

We hereby claim priority to and all the benefits under Title 35, United States Code, §119(e) of any United States provisional application(s).

- ☒ no such applications have been filed.
- ☐ such applications have been filed as follows:

APPLICATION NUMBER	DATE OF FILING (month, day, year)
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We hereby claim priority to and all the benefits under Title 35, United States Code, §120 of any United States application(s) listed below. If the above identified application is a continuation-in-part application, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this continuation-in-part application in accordance with Title 37, Code of Federal Regulations, Section 1.63(e).

- ☒ no such applications have been filed.
- ☐ such applications have been filed as follows:

APPLICATION NUMBER	DATE OF FILING (month, day, year)	STATUS (patented, pending, abandoned)
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### POWER OF ATTORNEY

As named inventors, we hereby appoint the following attorneys and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith with full power of substitution and revocation. (all names listed with corresponding registration numbers)

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### DECLARATION

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

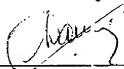
Dated: 15 October, 2001

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